AMERICAN

Gas Light and Heat Company,

No. 119 SOUTH FOURTH STREET,

PHILADELPHIA.

Gas heating

President,
S. P. M. TASKER.

Vice-President,
HON. JOHN REILLY.

Directors,

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Secretary and Treasurer,
D. R. B. NEVIN.

Correspondence Solicited. Circulars on Application.

THE AMERICAN GAS LIGHT AND HEAT COMPANY,

119 South 4th Street, Philadelphia.

THIS Company offers to the public a method of supplying both light and heat to cities, towns, and industrial establishments which is simple, direct, and efficient in the highest degree. In the absence of natural gas, no source of supply for either light or heat can be so ready and inexpensive as a perfectly formed gas from oil or petroleum; and proper methods of burning it show that no other material has so much illuminating and heating capacity.

The processes represented by the Company have been in use for supplying the town of Darby, Pa., for one year past, and have furnished all the gas used for illumination at that place. The Company have also an experimental plant at Darby for melting steel, ready for any trial, and working most successfully. At these works, the direct and effective methods represented by the Company may at any time be inspected by those desiring to obtain a working plant elsewhere.

HEATING AND LIGHTING BY THE USE OF OIL GAS.

THE American Gas Light and Heat Company may fairly claim that it represents the greatest degree of advancement now known to science, in both the processes of gas manufacture for illumination and in the making and utilization of gas for heating purposes. It is the good fortune of the inventions covered by its patents, that the methods of manufacture and of use in both cases may be, and are, conducted by the use of a simple and inexpensive plant of machinery, and without the duplication of costly

fixtures when changing from illuminating to heating processes. Any town or city which may not require more that 50,000 cubic feet daily for illumination, can be easily and cheaply supplied by a single bench of retorts, with the usual pipe connections.

In this process of gas generation, there is no bulky stock of coal or other materials to be gathered, no waste to be removed, and nothing approaching the amount of space usually taken up with unsightly fixtures is required. The gas-holder is the most conspicuous structure retained, and this may be kept with less than the usual storage capacity. These explanations may be useful to the authorities of towns now badly and expensively lighted, and whose experience suggests caution as to spending large sums of money in erecting experimental works in order to get relief from some existing defect. The present method of using ordinary coal gas is felt to be expensive and wasteful, yet for cities and towns where the water-gas processes have been tried, there are few cases where the results of any attempt to use other than coal gas have been satisfactory.

The gas in the works of the American Gas Light and Heat Company is made from oil, petroleum, and it is a pure and direct product, nearly 80 per cent. of its volume being of absolute combustibles, and 15 per cent, being a partial supporter of combustion.

The analysis made by Prof. Stephens, of Girard College, and of the Philadelphia City Gas Works, shows 76.2 per cent. of hydro-carbons, and 15.2 per cent. of carbon monoxide, a partial supporter of combustion, with 3.6 per cent. of oxygen and the small remainder of nitrogen with one per cent. only of carbon dioxide. Its purity is the result of the use of a pure oil only, for volatilization with superheated steam and a small but necessary proportion of air. These constituents yield some ammonia and some carbon dioxide, both of which are easily separated by the usual purifications, the ammonia by washing and the carbon dioxide by lime. The gas as delivered to the holder is a *fixed gas*, incapable of stratification or dissociation during any reasonable period of storage. It is also of the highest illuminating capacity, as

testified by Prof. Stephens, being of 29 candle power, and eliciting from him the strong expression that "*The gas is a permanent one, with almost no condensation in the pipes, and is the most brilliant gas I have ever examined.*" His further expressions of praise for its high qualities will be found in his letter printed at the close of this paper.

The key to the unusual success of this method of gas manufacture is in the simplicity of the methods of dissociation, which is effected by the use of superheated steam as a first step by which a perfect vapor is formed in the atomizer, and this vapor is passed immediately to the heated retorts for its complete expansion into gas. All the transitions are natural and regular, and are secured by the proper accessions of heat, while nothing is burned or destroyed by the use of excessive heat.

We have thus described the processes employed by these works because such description will enable the authorities of any town or city to judge of the general question as to its comparative value. The oil used is incomparably less bulky, less costly to handle, and cheaper as a raw material, than gas coals. The benches are much simpler, less costly to erect, and easier to work, and the gas, as delivered from the retorts, is far superior to coal gas even without purification, but it is easily purified and is then intensely luminous.

The difficulties heretofore experienced in converting oil into gas have been due to other causes than want of original fitness; apparently, the chief injury was due to overheating and burning the oil without supplying it with the natural associates required in gaseous combinations. The hydrogen of dissociated steam affords this requisite, and under proper manipulation the oil vaporizes readily, uniting with the hydrogen, and forming the maximum proportion of hydro-carbons, the oxygen having less affinity for the carbon, but still forming a very small percentage of carbon dioxide, easily removed in purification.

It is proved by these processes, that the great heat of the incandescent coal or coke used in the water gas furnace, is not necessary for dissociation, and, is at the same time, destructive of

all illuminating qualities, converting the gas into carbon dioxide chiefly, with large proportions of nitrogen. This gas it is customary to convert into illuminating gas by the use of naphtha, the resulting compound being both costly and dangerous, and not a fixed gas at all.

In comparison with ordinary coal gas, the gas made by our methods has none of the condensible constituents or impurities which are found in coal gas, which are in fact chiefly vapors and which should be, but are not properly converted into gas.

These constituents condense in various forms, as tar, ammonia, soot, and other residuals, and, after the most labored efforts at purification, the illuminating power remains low, at 14 to 16 candle power, and is burned with such incomplete combustion as to deposit soot or other forms of carbon. There are very few works making coal gas, which do not "enrich" their gas with some form of volatilizable product, benzine, naphtha or gasoline, this volatilization being effected at a temperature too low to fix the resulting mixture as a gas. Without this enriching process, the coal gas would be deficient in luminosity, and it is at all times saturated with condensible vapors when first made, many of them not being wholly removed. The average candle-power test, to which the gas made at the Philadelphia City Works is brought up, does not exceed seventeen candles, while the gas produced at Darby is shown by Professor Stephens's analysis to have an illuminating power of twenty-nine candles.

The especial superiority of this process of gas manufacture over any form of coal gas, or of so-called water gas manufacture, is in the small cost and direct working of the generating plant, the readiness with which the materials may be obtained and handled, and the purity and high-illuminating power of the gas produced.

These works may, therefore, be substituted for any ordinary coal gas or other works, in any town now supplied with gas, at very small cost for alterations, and with a practical economy in working of fully one-half the current cost of coal gas, also affording a greatly superior light.

GAS USED FOR HEATING PURPOSES.

The exigencies of the use of heat for metallurgic purposes have led to the generation of fuel-gas by the simplest processes of volatilization, and, therefore, containing every impurity connected with the material used in generation. Using bituminous coal chiefly if not wholly for this purpose, the gaseous products volatilized have been mostly impure vapors rather than gases, passing off at temperatures too low to give them permanence, and, therefore, condensing as tar, tarry waters, and mixed fluids, separating the larger part of their original volume in these condensations and purifications, before they are fit for storage, and for use in the cool state as illuminants.

It is not possible to make gas by the standard methods in use at illuminating gas works, without the loss of half the original volume of combustible elements through the condensing and purifying processes. The coking or roasting process necessarily delivers a large share of the vapors or volatilizations from the generators at a temperature too low to form a fixed gas, and being cooled as they pass forward, without further curing, to the several purifications and washings, they are condensed and eliminated as waste products or residuals, certainly not valuable as gases, although still volatilizable and capable of being made into fixed gas under proper conditions. All forms of tar and all oily residuals, as well as all forms of soot or other carbon deposits, are simply solid forms of that which might be made a fixed gas, to be burned for either heating or illuminating purposes.

But the volatilizations of the direct combustion of coal, known as producer gases, are still less valuable for actual combustion, because two-thirds of their volume are made up of incombustibles: the proportion of carbonic acid gas is 5 to 15 per cent. of the whole, and the nitrogen alone constitutes nearly 66 per cent., as shown by an analysis of the producer gas of the Midvale Steel Works, made in 1883, and recently made public.

The fitness of this oil gas for heating purposes when burned with a proper mixture of air is a most valuable feature, and one

calculated to double the practical value of any plant where it is made. It is evident that a very little time only will bring about the perfection of appliances for house or domestic uses, as well as for the higher heats required in manufactories and especially in metallurgic operations. A gas plant to be first applied to the purposes of lighting, may almost at once be applied to heating purposes. The same pipes may be used for both in many cases, and the adjunct blast of air may be supplied by the local power of any factory or mill. In most cases the adjunct air blast may be used without heating it, the most intense heat required for forges, welding, shaping, and all ordinary work will readily be developed by a moderate cold blast. The range of uses for this heating gas is almost unlimited, because the fuel furnished by the hydro-carbon gas is pure, and wholly combustible, when burned with admixture of common air.

The oil gas made by the American Gas Light and Heat Company's Works is thus shown to be adapted to heating purposes, when burned without, or with an air blast that ensures the most absolutely complete combustion, and develops the maximum of heat. In most cases gases are burned as wastefully as solid fuels are, the air blast being in excess or in deficiency as compared with the combustible elements. The heat generated by the combustion that does occur, is, much of it, carried away by the unburned combustibles, or by the excessive air blast, the smoke and gases escaping by the flues. In the combustion of this oil gas there is no smoke, and scarcely any flue to the furnace; a short flame, delivered outward at the bottom of the furnace is the only escape, and the gases, which so escape, are all completely burned.

This complete combustion is effected by the adjustment of the gas blast so as to deliver an exact equivalent of air, the two blasts or volumes being mingled at the entrance to the furnace, and the adjustments being such that they burn instantly, and with absolute completeness. The intensity of heat so developed is far in excess of that produced by any other mode of burning the fuel-gas, which is a rich hydro-carbon, and capable of union with fifteen times its volume of air, and then forming an explosive mix-

ture, and burning with intense heat. As the components in this combustion are chiefly oxygen in the air, and hydrogen in the gas, the result is the heat of the oxy-hydrogen blowpipe in a great degree. It is sufficient to melt any of the metals, although now experimentally employed in a furnace of small size, and without recuperators, or other aids to the concentration of the heat.

It is well known that the complete combustion of gas mixed with air in equivalent proportions is a source of heat far more intense than that resulting from ordinary and unequal union of the air with any substances undergoing combustion. No solid can be instantly burned, whether coal, wood, or oil, and no column or current of undivided gases, however combustible, burns completely, without being diffused through air, oxygen, or some other supporter of combustion.

The degree of heat required in metallurgic processes cannot be attained by ordinary methods without great care to secure its accumulation through the aid of regenerating furnaces, or recuperators. The aim in the existing processes is to accumulate the requisite heat, rather than to create it by one direct process, or as the result of one immediate and complete combustion. Yet the blow-pipe is a type of heat generation that should be in the metallurgic furnace, and in fact the complete combustion indicated by instant action, generates such a heat and gives it the definiteness of position, and ease of access, not found and not possible in the Siemens or Bessemer furnaces.

The forms of furnace so far tried in the use of this gas heating have not been many, but it is admirably adapted to crucible steel melting, to forging, welding, and everything that has been tried. There is not any objection to the enlargement of the present trial furnace, suiting it to heavy as well as to light work.

And it is a conspicuous point that the heat and the gas involved in it are neutral, non-corrosive and non-oxidizing. No scale forms in welding or forging, nor is it necessary to cover melted steel in the pot to prevent oxidation. There is no oxygen or acid present in excess of that which is perfectly neutralized in

the combustion. In this respect the distinction from ordinary furnace heats and forge fires is very great and very valuable.

The original type and standard form of furnace employed for illustration of the principles represented by this new form of metallurgic heat, is a rectangular brick structure only 3 by 4 feet and 3 feet in height, the interior capacity being sufficient for one or two pots containing a charge of 100 pounds each of steel to be melted. Into this furnace at the opposite side of its longer extension, two pipes of $1\frac{1}{2}$ inches diameter each, enter from a common air blast, delivering equal volumes with a pressure of $8\frac{1}{2}$ ounces only, and these pass through tubes at the upper side of the furnace, or above the level of the materials to be melted. Into each of these air-pipes a connection with the gas supply is made, the gas being delivered from below, at right angles to the air-blast and air-pipe, and thus forming a thorough mixture of the air and gas as they both enter the furnace. In this condition they undergo immediate and complete combustion, burning explosively, but with resulting condensation of volume, rather than expansion, because of the absolute neutralization resulting from the combinations.

The whole volume of the gases introduced is combustible, and the oxygen of the air-blast effects its complete combustion with condensation of the volumes burned. Expansion of volume would take place if volumes of unburned hydrogen or hydro-carbons were passing away as smoke or smoky vapors, or if volumes of air were brought in by the blast to be heated, but not burned, and therefore to pass off in an ascending column by the flue.

HEAT FROM COMBUSTION OF FUEL GASES.

The use of fuel gases in metallurgic works of all classes is certain to become universal very soon, and it is also certain that the substitution of a better process for the Siemens regenerative furnace is to take place among the earliest of the coming changes. In the districts supplied with natural gas the larger works are already using that as fuel, in most cases wastefully, but in all

instances with a great improvement of the product, and a degree of economy in cost which shows that the required gas could be made from oil, if necessary.

It is easy and practicable to carry the oil to any point of the seaboard or of the interior, and to use it as freely in one locality as another. It is otherwise with coal, and the cost of coal transportation will, as it has already done, put all large iron working establishments at great disadvantage, if located at points remote from immediate districts.

Coal cannot be burned in any furnace with its maximum calorific effect, and no possible improvement in the methods of combustion can overcome this difficulty and consequent loss. Oil can be burned after proper volatilization and due conversion into a fixed gas by processes as direct and inexpensive as the generation of producer gas. Its heating power when so developed is far greater than that of any form of gas now used for heating purposes in metallurgic works, because its entire volume, almost, is directly combustible, 76.2 per cent. being hydro-carbons, 15.2 carbon monoxide, and 3.6 per cent. oxygen, a total of 95 per cent. of direct combustibles.

These processes therefore offer the most undoubted superiority as compared with any existing gaseous fuels other than natural gas, and even this may be found so difficult of manipulation or so deficient in carbon, as to render the use of oil gas preferable.

In all the metallurgic processes now in use, great quantities of gaseous fuel escape unburned in consequence of the absence of suitable attempts to secure proper equivalents of the gases burned, and therefore their complete combustion. The air blast is always in excess of the possible combination of its oxygen with the equivalents of carbon and of hydrogen, and an enormous volume goes out at the flues, carrying away half the heat generated by what is actually burned. In the processes of this Company there is no such excess of the air blast, and no considerable volume escapes by the flue or otherwise except as the most condensed product of combustion. In fact there is no flue, in the usual sense, and the escaping volume is less than the measured volume of the incoming combustibles.

DISSOCIATION AT LOW TEMPERATURES.

The dissociation of steam for the production of hydrogen gas has always heretofore been effected by the destructive heat of incandescent fuel, and it is the primary step in all water gas works to so employ and consume the heat of a large body of fuel, before any form of gas for either heating or illumination is separated from either the steam or the coal. The object of this costly process is only the dissociation of hydrogen, the other component of the steam becoming carbonic acid or carbonic oxide, and in either case being valueless for illumination, although the carbon monoxide has some value for heat.

But it is certain that this method of dissociation is not indispensable or necessary, the most complete separation of the constituent gases of super-heated steam may be effected at temperatures below that of the dry steam itself, if a proper accession of oil in vapor and of air at a moderate temperature can be driven into the atomizing chamber in due proportion to the steam, the result being the formation of a perfectly diffused vapor at a temperature not above 350°, which vapor expands without condensation into a fixed gas on its passage through retorts of 650° to 950°, retaining as such fixed gas all the hydro-carbon compounds originally in the oil.

The fact that the desired dissociation of hydrogen is perfectly effected by this process, and at temperatures so low that no heat is lost, and none of the combustibles are destroyed or consumed in a wasteful way, is evident and demonstrable. The superheated steam is merely dry steam not above 350°, and the adjuncts of oil and air are much lower in temperature. The resulting vapor is not much below the heat of the steam, yet still below it, as there is no heat applied directly to the atomizer. The vapor will not condense on heated surfaces, and does not condense on passing into the retorts, in which it is expanded to a fixed gas under temperatures never rising above 1000°, or possibly 1100°.

The result of this process is an overwhelming proof of the fallacy of the theory of dissociation at high temperatures only, or of

the necessity of employing the incandescent fuel for such dissociation. If the oil were not added, it is still certain that the steam would be decomposed into its component gases by the moderate temperatures of the retorts, accession of air being provided, as is also done for the oil gas.

The carburetting required for illumination might then be effected by the use of naphtha, or other of the lighter hydro-carbons, and a fixed gas of some value or degree would be produced. The point is, that the costly process now resorted to for separating hydrogen is not necessary under any circumstances. It is costly, and at the same time destructive of the constituents intended to be used for either heating or lighting.

The condition of hydro-carbon vapors when mixed with steam in any manner is favorable to dissociation and to the liberation of hydrogen. Combustion once begun with hydro-carbon so separated, may sometimes be continued with only the hydrogen as a fuel, the steam being burned, apparently. It is necessary to obtain a heat above the degree required for superheating in order to prepare the hydrogen for such continued combustion.

ILLUMINATING POWER.

Without instituting comparisons with competing organizations and methods of manufacture of gas for illuminating purposes, the American Gas Light and Heat Company claim in favor of their process or system the following specific and pronounced advantages, which have been *thoroughly, efficiently and substantially* tested by some of the leading gas authorities of the country:

1. Cheapness of Construction.—The apparatus has no complicated machinery about it, and is so simple in its mechanism, that any person of ordinary intelligence, under instructions for forty-eight hours, can manage it with all its details as successfully and efficiently as could be done by a practical engineer. No purifiers or other expensive apparatus, except for washing, are required to eliminate sulphur and other offensive products, simply because they *do not* exist.

2. Economy.—This simplicity of construction is an element of great economy in the practical workings of our system for illuminating purposes. The labor of a single man is all that is required to generate *fifty thousand cubic feet of gas in twenty-four hours.* The gas generated by this process gives a soft, brilliant and uniform light such as is furnished by the very best quality of *fixed* gas.

In regard to cost, there is, in the first place, a great saving in handling the material. The retorts do not have to be opened every few hours for the reception of the charge, its introduction into the retorts being continuous. A much larger amount of gas can be made from petroleum by this process in the same length of time, than from coal, hence a saving both in labor, and the wear and tear of works.

3. Purity.—A most important element of good gas is its purity. The gas made by this method is so pure that it emits less *offensive odors than any other of the illuminating gases.* The quality of the gas is remarbable for its purity, cleanliness, brilliancy, great illuminating power, and economy in manufacture and use.

In this connection, we call the special attention of coal gas companies to the great value of hydro-carbon gas as an enricher of gas of low candle-power. By the use of our process, *natural* gas and coal gas can be raised to any desired standard of quality required for illuminating purposes.

COST OF PLANT.

The actual cost of a bench in position, capable of generating 50,000 cubic feet of gas in twenty-four hours, is twelve hundred dollars. This includes castings, fire and other bricks, and labor —in fact, everything essential to the perfect working of the system, with the exception of a boiler.

CHEMICAL ANALYSIS OF GAS.

FROM THE GAS WORKS AT DARBY, DELAWARE COUNTY, PENNSYLVANIA.

BY PROF. LEMUEL STEPHENS, OF PHILADELPHIA.

100 parts of Gas gave :

Heavy hydro-carbon,	39.20
Light hydro-carbon C.H. (Methane),	1.50
Carbon monoxide (C.O.),	15.20
Hydrogen (H),	35.50
Oxygen (O),	3.60
Nitrogen (N),	4.00
Carbon dioxide (Co_2),	1.00
	100.00

Specific Gravity, 7421
Candlepower, 29.

TESTIMONIALS.

GIRARD COLLEGE, Philadelphia, October 5th, 1887.

Prof. Lemuel Stephens, for over a quarter of a century connected with the scientific department of Girard College, and one of the best recognized authorities in gas matters in the United States, and for many years connected with the Philadelphia Gas Works, says :

"On examining your process minutely I found that a burner consuming 5 cubic feet of gas per hour gave the high illuminating power of 29 candles. The gas, moreover, is a permanent one with almost no condensation whatever in the pipes, and is certainly the most brilliant gas I ever examined or analyzed. The carbonic oxide (15.2 in my professional report), is no injury whatever to the gas, but increases the heating power. The great amount of carbon in the gas is one of its virtues."

LEMUEL STEPHENS.

Steam + blast 800 27 lb
Coal for 1000 cub. ft. 28 lb Lykens Val
Crude Oil " " 6 1/2 Gal.
Labor 1 man per day

Darby (Pa.) Gas Light Company.

Chas. F. Cattell, Superintendent, under recent date, writes as follows:

"I have been Superintendent Darby Pa., Gas Works for nearly three years. We have hitherto been making coal gas for our consumers. I now make oil gas by your process exclusively of 22 candle power.

This gas gives entire satisfaction; in fact, our consumers would not be content to go back to the use of coal gas light.

The cost of making gas by your process is fifty per cent. less than by the coal gas methods.

We have been using your gas for more than a year. It gives a pure white smokeless light and I repeat emphatically that there is no complaint whatever from any of our consumers. It is a pleasure to operate your bench as compared with the old style coal bench, as I fill my holder once a week and bank my fires the balance of the week."

1 Bench produces 1000 ft. per hour
22 lbs coke in 24 hrs. – 3148.21 – Pal.

The following testimonial is from the well-known Consulting Engineer, J. Thorpe Potts, Esq., for many years the American agent of the Siemens-Martin process:

Philadelphia, Pa., October 21, 1887.

I have been paying much attention to the apparatus and working of the plant at Darby, for the manufacture of illuminating gas, and its adaptation to heating purposes.

In my opinion, this gas is a very great stride in the working of metallurgical furnaces, as well as for every manufacture where heat is required.

It has so many advantages. Some of them are, its economy in construction (or its small cost), compared with anything now in existence; the cost of furnace is considerably reduced for any required purpose, over any that will give the same results, now used; saving in labor, by reason of its freedom from ashes, and its cleanliness; the small space the furnace will occupy, compared with others, to gain the some amount of work, etc.

about 8 to 9 per ....

The perfect control of the character of the flame, which you have, will insure the best results.

The crude works at Darby give a good idea of the principles and their capability of being made efficient for large plants or for small.

J. THORPE POTTS.

Representing other parties, I visited Newcastle, Del., in company with several experts to examine the new process for generating gas-light and heat, adopted by the American Gas Light and Heat Company, 119 South Fourth Street, Philadelphia. The object of the machine is to make gas from crude petroleum, air, and super-heated steam, for heating and illuminating purposes. It is certainly very simple in its construction and easily manipulated. At twenty-five minutes past one o'clock (in the presence of Engineer Hutchinson, of Philadelphia, and several manufacturers from Central Pennsylvania) the gas was generated in the combustion chamber, and in less than one hour and a half the furnace was heated. A piece of 6-inch wrought iron pipe, $\frac{5}{16}$ inches thick, was then thrust into the furnace, and, in five minutes, it was heated to a *white* heat. During this process, the flame in the furnace was of a light blue color, and of very high temperature. On the whole I was very much pleased with the apparatus and its successful workings, and consider its exhibition, on the occasion referred to, a pronounced success. I learn that quite a number of scientific men have expressed most favorable opinions of this machine and its operations.

CHAS. G. DARRAGH, C. E.
with Wilson Brothers & Co., 435 Chestnut Street, Philadelphia.

You must accept my sincere thanks for the privilege afforded me of examining your new method of manufacturing gas from petroleum, for heating and illuminating purposes.

I can say truly that it is the best and cheapest method yet devised for using petroleum for such purposes. First, because in converting the liquid into gases by your method of hot tubes, none whatever is lost, but the whole converted into more or less permanent gases, all of which may be utilized for producing heat, and far more heat can be obtained from the gases than could be gotten from the same amount of the oil, on account of the admixture of hydrogen from the decomposition of water, the latter gas giving the largest amount of heat known. . Secondly, the gas thus made is under the entire control of the party using it, and the apparatus so simple that it does not require an expert to use it.

Again, the admixture of air with the vapor of petroleum before it is converted into gases does not make the resulting gases any more explosive than our ordinary illuminating gas, as I proved by a few simple tests, which shows to my mind the oxygen of the air is used in converting the higher hydro-carbons into gaseous products.

My observations extended only to the use of the gas just as it was made, and to that extent I think nothing more could be desired.

As to its use for manufacturing illuminating gas, I think it is decidedly the cheapest method yet devised, and I believe the gas would be so rich as to allow some dilution with other gases to bring it to the proper standard.

E. T. Fristoe,
Prof. Chemistry, Columbian University, Washington, D. C.

OLIVER BRADEN & CO., PRINTERS, 119 SOUTH 4TH ST., PHILADA.

Consumption of
Coal year @ 5/–
25% of [illegible]
Cost of vessel
1200–